Subelement A – Principles: 8 Key Topics, 8 Exam Questions

Key Topic 1: Electrical Elements

3-1A1 The product of the readings of an AC voltmeter and AC ammeter is called:
- A. Apparent power.
- B. True power.
- C. Power factor.
- D. Current power.

3-1A2 What is the basic unit of electrical power?
- A. Ohm.
- B. Watt.
- C. Volt.
- D. Ampere.

3-1A3 What is the term used to express the amount of electrical energy stored in an eleetrostatic field?
- A. Joules.
- B. Coulombs.
- C. Watts.
- D. Volts.

3-1A4 What device is used to store electrical energy in an electrostatic field?
- A. Battery.
- B. Transformer.
- C. Capacitor.
- D. Inductor.

3-1A5 What formula would determine the inductive reactance of a coil if frequency and coil inductance are known?
- A. $X_L = \pi f L$
- B. $X_L = 2\pi f L$
- C. $X_L = 1 / 2\pi f C$
- D. $X_L = 1 / R2+X2$

3-1A6 What is the term for the out-of-phase power associated with inductors and capacitors?
- A. Effective power.
- B. True power.
- C. Peak envelope power.
- D. Reactive power.

Answer Key: 3-1A1: A 3-1A2: B 3-1A3: A 3-1A4: C 3-1A5: B 3-1A6: D

Key Topic 2: Magnetism

3-2A1 What determines the strength of the magnetic field around a conductor?

A. *The resistance divided by the current.*
B. The ratio of the current to the resistance.
C. The diameter of the conductor.
D. The amount of current.

3-2A2 What will produce a magnetic field?

A. A DC source not connected to a circuit.
B. The presence of a voltage across a capacitor.
C. A current flowing through a conductor.
D. The force that drives current through a resistor.

3-2A3 When induced currents produce expanding magnetic fields around conductors in a direction that opposes the original magnetic field, this is known as:

A. Lenz's law.
B. Gilbert's law.
C. Maxwell's law.
D. Norton's law.

3-2A4 The opposition to the creation of magnetic lines of force in a magnetic circuit is known as:

A. Eddy currents.
B. Hysteresis.
C. Permeability.
D. Reluctance.

3-2A5 What is meant by the term "back EMF"?

A. A current equal to the applied EMF.
B. An opposing EMF equal to R times C (RC) percent of the applied EMF.
C. A voltage that opposes the applied EMF.
D. A current that opposes the applied EMF.

3-2A6 Permeability is defined as:

A. The magnetic field created by a conductor wound on a laminated core and carrying current.
B. The ratio of magnetic flux density in a substance to the magnetizing force that produces it.
C. Polarized molecular alignment in a ferromagnetic material while under the influence of a magnetizing force.
D. None of these.

Answer Key: 3-2A1: D 3-2A2: C 3-2A3: A 3-2A4: D 3-2A5: C 3-2A6: B

Key Topic 3: Materials

3-3A1 What metal is usually employed as a sacrificial anode for corrosion control purposes?
A. Platinum bushing.
B. Lead bar.
C. Zinc bar.
D. Brass rod.

3-3A2 What is the relative dielectric constant for air?
A. 1
B. 2
C. 4
D. 0

3-3A3 Which metal object may be least affected by galvanic corrosion when submerged in seawater?
A. Aluminum outdrive.
B. Bronze through-hull.
C. Exposed lead keel.
D. Stainless steel propeller shaft.

3-3A4 Skin effect is the phenomenon where:
A. RF current flows in a thinner layer of the conductor, closer to the surface, as frequency increases.
B. RF current flows in a thinner layer of the conductor, closer to the surface, as frequency decreases.
C. Thermal effects on the surface of the conductor increase the impedance.
D. Thermal effects on the surface of the conductor decrease the impedance.

3-3A5 Corrosion resulting from electric current flow between dissimilar metals is called:
A. Electrolysis.
B. Stray current corrosion.
C. Oxygen starvation corrosion.
D. Galvanic corrosion.

3-3A6 Which of these will be most useful for insulation at UHF frequencies?
A. Rubber.
B. Mica.
C. Wax impregnated paper.
D. Lead.

Answer Key: 3-3A1: C 3-3A2: A 3-3A3: D 3-3A4: A 3-3A5: D 3-3A6: B

Key Topic 4: Resistance, Capacitance & Inductance

3-4A1 What formula would calculate the total inductance of inductors in series?
- A. $L_T = L_1 / L_2$
- B. $L_T = L_1 + L_2$
- C. $L_T = 1 / L_1 + L_2$
- D. $L_T = 1 / L_1 \times L_2$

3-4A2 Good conductors with minimum resistance have what type of electrons?
- A. Few free electrons.
- B. No electrons.
- C. Some free electrons.
- D. Many free electrons.

3-4A3 Which of the 4 groups of metals listed below are the best low-resistance conductors?
- A. Gold, silver, and copper.
- B. Stainless steel, bronze, and lead.
- C. Iron, lead, and nickel.
- D. Bronze, zinc, and manganese.

3-4A4 What is the purpose of a bypass capacitor?
- A. It increases the resonant frequency of the circuit.
- B. It removes direct current from the circuit by shunting DC to ground.
- C. It removes alternating current by providing a low impedance path to ground.
- D. It forms part of an impedance transforming circuit.

3-4A5 How would you calculate the total capacitance of three capacitors in parallel?
- A. $C_T = C_1 + C_2 / C_1 - C_2 + C_3$.
- B. $C_T = C_1 + C_2 + C_3$.
- C. $C_T = C_1 + C_2 / C_1 \times C_2 + C_3$.
- D. $C_T = 1 / C_1 + 1 / C_2 + 1 / C_3$.

3-4A6 How might you reduce the inductance of an antenna coil?
- A. Add additional turns.
- B. Add more core permeability.
- C. Reduce the number of turns.
- D. Compress the coil turns.

Answer Key: 3-4A1: B 3-4A2: D 3-4A3: A 3-4A4: C 3-4A5: B 3-4A6: C

Key Topic 5: Semi-conductors

3-5A1 What are the two most commonly-used specifications for a junction diode?
A. *Maximum forward current and capacitance.*
B. Maximum reverse current and PIV (peak inverse voltage).
C. Maximum reverse current and capacitance.
D. Maximum forward current and PIV (peak inverse voltage).

3-5A2 What limits the maximum forward current in a junction diode?
A. The peak inverse voltage (PIV).
B. The junction temperature.
C. The forward voltage.
D. The back EMF.

3-5A3 MOSFETs are manufactured with THIS protective device built into their gate to protect the device from static charges and excessive voltages:
A. Schottky diode.
B. Metal oxide varistor (MOV).
C. Zener diode.
D. Tunnel diode.

3-5A4 What are the two basic types of junction field-effect transistors?
A. N-channel and P-channel.
B. High power and low power.
C. MOSFET and GaAsFET.
D. Silicon FET and germanium FET.

3-5A5 A common emitter amplifier has:
A. Lower input impedance than a common base.
B. More voltage gain than a common collector.
C. Less current gain than a common base.
D. Less voltage gain than a common collector.

3-5A6 How does the input impedance of a field-effect transistor compare with that of a bipolar transistor?
A. An FET has high input impedance; a bipolar transistor has low input impedance.
B. One cannot compare input impedance without first knowing the supply voltage.
C. An FET has low input impedance; a bipolar transistor has high input impedance.
D. The input impedance of FETs and bipolar transistors is the same.

Answer Key: 3-5A1: D 3-5A2: B 3-5A3: C 3-5A4: A 3-5A5: B 3-5A6: A

Key Topic 6: Electrical Measurements

3-6A1 An AC ammeter indicates:

A. Effective (TRM) values of current.
B. Effective (RMS) values of current.
C. Peak values of current.
D. Average values of current.

3-6A2 By what factor must the voltage of an AC circuit, as indicated on the scale of an AC voltmeter, be multiplied to obtain the peak voltage value?

A. 0.707
B. 0.9
C. 1.414
D. 3.14

3-6A3 What is the RMS voltage at a common household electrical power outlet?

A. 331-V AC.
B. 82.7-V AC.
C. 165.5-V AC.
D. 117-V AC.

3-6A4 What is the easiest voltage amplitude to measure by viewing a pure sine wave signal on an oscilloscope?

A. Peak-to-peak.
B. RMS.
C. Average.
D. DC.

3-6A5 By what factor must the voltage measured in an AC circuit, as indicated on the scale of an AC voltmeter, be multiplied to obtain the average voltage value?

A. 0.707
B. 1.414
C. 0.9
D. 3.14

3-6A6 What is the peak voltage at a common household electrical outlet?

A. 234 volts.
B. 117 volts.
C. 331 volts.
D. 165.5 volts.

Answer Key: 3-6A1: B 3-6A2: C 3-6A3: D 3-6A4: A 3-6A5: C 3-6A6: D

Key Topic 7: Waveforms

3-7A1 What is a sine wave?

A. A constant-voltage, varying-current wave.

B. A wave whose amplitude at any given instant can be represented by the projection of a point on a wheel rotating at a uniform speed.

C. A wave following the laws of the trigonometric tangent function.

D. A wave whose polarity changes in a random manner.

3-7A2 How many degrees are there in one complete sine wave cycle?

A. 90 degrees.

B. 270 degrees.

C. 180 degrees.

D. 360 degrees.

3-7A3 What type of wave is made up of sine waves of the fundamental frequency and all the odd harmonics?

A. Square.

B. Sine.

C. Cosine.

D. Tangent.

3-7A4 What is the description of a square wave?

A. A wave with only 300 degrees in one cycle.

B. A wave whose periodic function is always negative.

C. A wave whose periodic function is always positive.

D. A wave that abruptly changes back and forth between two voltage levels and stays at these levels for equal amounts of time.

3-7A5 What type of wave is made up of sine waves at the fundamental frequency and all the harmonics?

A. Sawtooth wave.

B. Square wave.

C. Sine wave.

D. Cosine wave.

3-7A6 What type of wave is characterized by a rise time significantly faster than the fall time (or vice versa)?

A. Cosine wave.

B. Square wave.

C. Sawtooth wave.

D. Sine wave.

Answer Key: 3-7A1: B 3-7A2: D 3-7A3: A 3-7A4: D 3-7A5: A 3-7A6: C

Key Topic 8: Conduction

3-8A1 What is the term used to identify an AC voltage that would cause the same heating in a resistor as a *corresponding value of DC voltage?*

A. Cosine voltage.
B. Power factor.
C. Root mean square (RMS).
D. Average voltage.

3-8A2 What happens to reactive power in a circuit that has both inductors and capacitors?

A. It is dissipated as heat in the circuit.
B. It alternates between magnetic and electric fields and is not dissipated.
C. It is dissipated as inductive and capacitive fields.
D. It is dissipated as kinetic energy within the circuit.

3-8A3 Halving the cross-sectional area of a conductor will:

A. Not affect the resistance.
B. Quarter the resistance.
C. Double the resistance.
D. Halve the resistance.

3-8A4 Which of the following groups is correct for listing common materials in order of descending conductivity?

A. Silver, copper, aluminum, iron, and lead.
B. Lead, iron, silver, aluminum, and copper.
C. Iron, silver, aluminum, copper, and silver.
D. Silver, aluminum, iron, lead, and copper.

3-8A5 How do you compute true power (power dissipated in the circuit) in a circuit where AC voltage and current are out of phase?

A. Multiply RMS voltage times RMS current.
B. Subtract apparent power from the power factor.
C. Divide apparent power by the power factor.
D. Multiply apparent power times the power factor.

3-8A6 Assuming a power source to have a fixed value of internal resistance, maximum power will be transferred to the load when:

A. The load impedance is greater than the source impedance.
B. The load impedance equals the internal impedance of the source.
C. The load impedance is less than the source impedance.
D. The fixed values of internal impedance are not relative to the power source.

Answer Key: 3-8A1: C 3-8A2: B 3-8A3: C 3-8A4: A 3-8A5: D 3-8A6: B

Key Topic 9: Ohm's Law-1

3-9B1 What value of series resistor would be needed to obtain a full scale deflection on a 50 microamp DC meter with an applied voltage of 200 volts DC?

A. 4 megohms.
B. 2 megohms.
C. 400 kilohms.
D. 200 kilohms.

3-9B2 Which of the following Ohms Law formulas is incorrect?

A. I = E / R
B. I = R / E
C. E = I x R
D. R = E / I

3-9B3 If a current of 2 amperes flows through a 50-ohm resistor, what is the voltage across the resistor?

A. 25 volts.
B. 52 volts.
C. 200 volts.
D. 100 volts.

3-9B4 If a 100-ohm resistor is connected across 200 volts, what is the current through the resistor?

A. 2 amperes.
B. 1 ampere.
C. 300 amperes.
D. 20,000 amperes.

3-9B5 If a current of 3 amperes flows through a resistor connected to 90 volts, what is the resistance?

A. 3 ohms.
B. 30 ohms.
C. 93 ohms.
D. 270 ohms.

3-9B6 A relay coil has 500 ohms resistance, and operates on 125 mA. What value of resistance should be connected in series with it to operate from 110 V DC?

A. 150 ohms.
B. 220 ohms.
C. 380 ohms.
D. 470 ohms.

Answer Key: 3-9B1: A 3-9B2: B 3-9B3: D 3-9B4: A 3-9B5: B 3-9B6: C

Key Topic 10: Ohm's Law-2

3-10B1 What is the peak-to-peak RF voltage on the 50 ohm output of a 100 watt transmitter?

A. 70 volts.
C. 140 volts.
B. 100 volts.
D. 200 volts.

3-10B2 What is the maximum DC or RMS voltage that may be connected across a 20 watt, 2000 ohm resistor?

A. 10 volts.
C. 200 volts.
B. 100 volts.
D. 10,000 volts.

3-10B3 A 500-ohm, 2-watt resistor and a 1500-ohm, 1-watt resistor are connected in parallel. What is the maximum voltage that can be applied across the parallel circuit without exceeding wattage ratings?

A. 22.4 volts.
C. 38.7 volts.
B. 31.6 volts.
D. 875 volts.

3-10B4 In Figure 3B1, what is the voltage drop across R1?

A. 9 volts.
C. 5 volts.
B. 7 volts.
D. 3 volts.

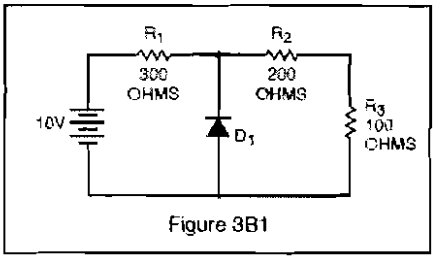

Figure 3B1

3-10B5 In Figure 3B2, what is the voltage drop across R1?

A. 1.2 volts.
C. 3.7 volts.
B. 2.4 volts.
D. 9 volts.

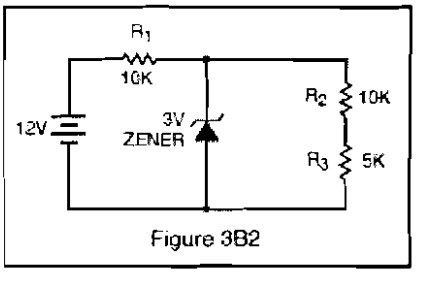

Figure 3B2

3-10B6 What is the maximum rated current-carrying capacity of a resistor marked "2000 ohms, 200 watts"?

A. 0.316 amps.
C. 10 amps.
B. 3.16 amps.
D. 100 amps.

Answer Key: 3-10B1: D 3-10B2: C 3-10B3: B 3-10B4: C 3-10B5: D 3-10B6: A

Key Topic 11: Frequency

3-11B1 What is the most the actual transmit frequency could differ from a reading of 462,100,000 Hertz on a frequency counter with a time base accuracy of ± 0.1 ppm?

A. 46.21 Hz.
B. 0.1 MHz.
C. 462.1 Hz.
D. 0.2 MHz.

3-11B2 The second harmonic of a 380 kHz frequency is:

A. 2 MHz.
B. 760 kHz.
C. 190 kHz.
D. 144.4 GHz.

3-11B3 The frequency that is 2 octaves higher than 1000 Hz is:

A. 4000 Hz.
B. 5000 Hz.
C. 2000 Hz.
D. 3000 Hz.

3-11B4 What is the most the actual transmitter frequency could differ from a reading of 156,520,000 hertz on a frequency counter with a time base accuracy of ± 1.0 ppm?

A. 165.2 Hz.
B. 15.652 kHz.
C. 156.52 Hz.
D. 1.4652 MHz.

3-11B5 What is the most the actual transmitter frequency could differ from a reading of 156,520,000 Hertz on a frequency counter with a time base accuracy of +/- 10 ppm?

A. 146.52 Hz.
B. 1565.20 Hz.
C. 10 Hz.
D. 156.52 kHz.

3-11B6 What is the most the actual transmitter frequency could differ from a reading of 462,100,000 hertz on a frequency counter with a time base accuracy of ± 1.0 ppm?

A. 46.21 MHz.
B. 10 Hz.
C. 1.0 MHz.
D. 462.1 Hz.

Answer Key: 3-11B1: A 3-11B2: B 3-11B3: A 3-11B4: C 3-11B5: B 3-11B6: D

Key Topic 12: Waveforms

3-12B1 At pi/3 radians, what is the amplitude of a sine-wave having a peak value of 5 volts?
A. -4.3 volts.
B. -2.5 volts.
C. +2.5 volts.
D. +4.3 volts.

3-12B2 At 150 degrees, what is the amplitude of a sine-wave having a peak value of 5 volts?
A. -4.3 volts.
B. -2.5 volts.
C. +2.5 volts.
D. +4.3 volts.

3-12B3 At 240 degrees, what is the amplitude of a sine-wave having a peak value of 5 volts?
A. -4.3 volts.
B. -2.5 volts.
C. +2.5 volts.
D. +4.3 volts.

3-12B4 What is the equivalent to the root-mean-square value of an AC voltage?
A. AC voltage is the square root of the average AC value.
B. The DC voltage causing the same heating in a given resistor at the peak AC voltage.
C. The AC voltage found by taking the square of the average value of the peak AC voltage.
D. The DC voltage causing the same heating in a given resistor as the RMS AC voltage of the same value.

3-12B5 What is the RMS value of a 340-volt peak-to-peak pure sine wave?
A. 170 volts AC.
B. 240 volts AC.
C. 120 volts AC.
D. 350 volts AC.

3-12B6 Determine the phase relationship between the two signals shown in Figure 3B3.
A. A is lagging B by 90 degrees.
B. B is lagging A by 90 degrees.
C. A is leading B by 90 degrees.
D. B is leading A by 90 degrees.

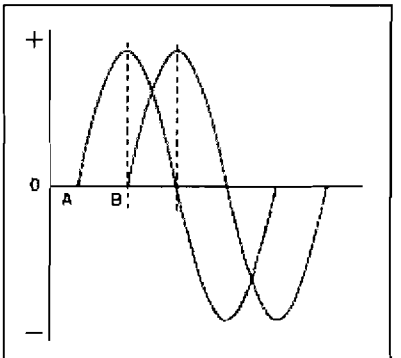

Fig. 3B3

Answer Key: 3-12B1: D 3-12B2: C 3-12B3: A 3-12B4: D 3-12B5: C 3-12B6: B

Key Topic 13: Power Relationships

3-13B1 What does the power factor equal in an R-L circuit having a 60 degree phase angle between the voltage and the current?

A. 0.414
B. 0.866
C. 0.5
D. 1.73

3-13B2 If a resistance to which a constant voltage is applied is halved, what power dissipation will result?

A. Double.
B. Halved.
C. Quadruple.
D. Remain the same.

3-13B3 746 watts, corresponding to the lifting of 550 pounds at the rate of one-foot-per-second, is the equivalent of how much horsepower?

A. One-quarter horsepower.
B. One-half horsepower.
C. Three-quarters horsepower.
D. One horsepower.

3-13B4 In a circuit where the AC voltage and current are out of phase, how can the true power be determined?

A. By multiplying the apparent power times the power factor.
B. By subtracting the apparent power from the power factor.
C. By dividing the apparent power by the power factor.
D. By multiplying the RMS voltage times the RMS current.

3-13B5 What does the power factor equal in an R-L circuit having a 45 degree phase angle between the voltage and the current?

A. 0.866
B. 1.0
C. 0.5
D. 0.707

3-13B6 What does the power factor equal in an R-L circuit having a 30 degree phase angle between the voltage and the current?

A. 1.73
B. 0.866
C. 0.5
D. 0.577

Answer Key: 13B1: C 13B2: A 13B3: D 13B4: A 13B5: D 13B6: B

Key Topic 14: RC Time Constants-1

3-14B1 What is the term for the time required for the capacitor in an RC circuit to be charged to 63.2% of the supply voltage?

A. An exponential rate of one.
B. One time constant.
C. One exponential period.
D. A time factor of one.

3-14B2 What is the meaning of the term "time constant of an RC circuit"? The time required to charge the capacitor in the circuit to:

A. 23.7% of the supply voltage.
B. 36.8% of the supply voltage.
C. 57.3% of the supply voltage.
D. 63.2% of the supply voltage.

3-14B3 What is the term for the time required for the current in an RL circuit to build up to 63.2% of the maximum value?

A. One time constant.
B. An exponential period of one.
C. A time factor of one.
D. One exponential rate.

3-14B4 What is the meaning of the term "time constant of an RL circuit"? The time required for the:

A. Current in the circuit to build up to 36.8% of the maximum value.
B. Voltage in the circuit to build up to 63.2% of the maximum value.
C. Current in the circuit to build up to 63.2% of the maximum value.
D. Voltage in the circuit to build up to 36.8% of the maximum value.

3-14B5 After two time constants, the capacitor in an RC circuit is charged to what percentage of the supply voltage?

A. 36.8 %
B. 63.2 %
C. 86.5 %
D. 95 %

3-14B6 After two time constants, the capacitor in an RC circuit is discharged to what percentage of the starting voltage?

A. 86.5 %
B. 13.5 %
C. 63.2 %
D. 36.8 %

Answer Key: 3-14B1: B) 3-14B2: D) 3-14B3: A) 3-14B4: C 3-14B5: C 3-14B6: B

Key Topic 15: RC Time Constants-2

3-15B1 What is the time constant of a circuit having two 220-microfarad capacitors and two 1-megohm resistors *all in parallel?*

A. 22 seconds.
B. 44 seconds.
C. 440 seconds.
D. 220 seconds.

3-15B2 What is the time constant of a circuit having two 100-microfarad capacitors and two 470-kilohm resistors all in series?

A. 470 seconds.
B. 47 seconds.
C. 4.7 seconds.
D. 0.47 seconds.

3-15B3 What is the time constant of a circuit having a 100-microfarad capacitor and a 470-kilohm resistor in series?

A. 4700 seconds.
B. 470 seconds.
C. 47 seconds.
D. 0.47 seconds.

3-15B4 What is the time constant of a circuit having a 220-microfarad capacitor and a 1-megohm resistor in parallel?

A. 220 seconds.
B. 22 seconds.
C. 2.2 seconds.
D. 0.22 seconds.

3-15B5 What is the time constant of a circuit having two 100-microfarad capacitors and two 470-kilohm resistors all in parallel?

A. 470 seconds.
B. 47 seconds.
C. 4.7 seconds.
D. 0.47 seconds.

3-15B6 What is the time constant of a circuit having two 220-microfarad capacitors and two 1-megohm resistors all in series?

A. 220 seconds.
B. 55 seconds.
C. 110 seconds.
D. 440 seconds.

Answer Key: 3-15B1: D 3-15B2: B 3-15B3: C 3-15B4: A 3-15B5: B 3-15B6: A

Key Topic 16: Impedance Networks-1

3-16B1 What is the impedance of a network composed of a 0.1-microhenry inductor in series with a 20-ohm resistor, at 30 MHz? *Specify your answer in rectangular coordinates.*

A. 20 -j19
B. 19 +j20
C. 20 +j19
D. 19 -j20

3-16B2 In rectangular coordinates, what is the impedance of a network composed of a 0.1-microhenry inductor in series with a 30-ohm resistor, at 5 MHz?

A. 30 -j3
B. 3 +j30
C. 3 -j30
D. 30 +j3

3-16B3 In rectangular coordinates, what is the impedance of a network composed of a 10-microhenry inductor in series with a 40-ohm resistor, at 500 MHz?

A. 40 +j31400
B. 40 -j31400
C. 31400 +j40
D. 31400 -j40

3-16B4 In rectangular coordinates, what is the impedance of a network composed of a 1.0-millihenry inductor in series with a 200-ohm resistor, at 30 kHz?

A. 200 - j188
B. 200 + j188
C. 188 + j200
D. 188 - j200

3-16B5 In rectangular coordinates, what is the impedance of a network composed of a 0.01-microfarad capacitor in parallel with a 300-ohm resistor, at 50 kHz?

A. 150 - j159
B. 150 + j159
C. 159 - j150
D. 159 + j150

3-16B6 In rectangular coordinates, what is the impedance of a network composed of a 0.001-microfarad capacitor in series with a 400-ohm resistor, at 500 kHz?

A. 318 - j400
B. 400 + j318
C. 318 + j400
D. 400 - j318

Answer Key: 3-16B1: C 3-16B2: D 3-16B3: A 3-16B4: B 3-16B5: C 3-16B6: D

Key Topic 17: Impedance Networks-2

3-17B1 What is the impedance of a network composed of a 100-picofarad capacitor in parallel with a 4000-ohm resistor, at 500 KHz? Specify your answer in polar coordinates.

A. 2490 ohms, /51.5 degrees
B. 4000 ohms, /38.5 degrees
C. 5112 ohms, /-38.5 degrees
D. 2490 ohms, /-51.5 degrees

3-17B2 In polar coordinates, what is the impedance of a network composed of a 100-ohm-reactance inductor in series with a 100-ohm resistor?

A. 121 ohms, /35 degrees
B. 141 ohms, /45 degrees
C. 161 ohms, /55 degrees
D. 181 ohms, /65 degrees

3-17B3 In polar coordinates, what is the impedance of a network composed of a 400-ohm-reactance capacitor in series with a 300-ohm resistor?

A. 240 ohms, /36.9 degrees
B. 240 ohms, /-36.9 degrees
C. 500 ohms, /-53.1 degrees
D. 500 ohms, /53.1 degrees

3-17B4 In polar coordinates, what is the impedance of a network composed of a 300-ohm-reactance capacitor, a 600-ohm-reactance inductor, and a 400-ohm resistor, all connected in series?

A. 500 ohms, /37 degrees
B. 400 ohms, /27 degrees
C. 300 ohms, /17 degrees
D. 200 ohms, /10 degrees

3-17B5 In polar coordinates, what is the impedance of a network comprised of a 400-ohm-reactance inductor in parallel with a 300-ohm resistor?

A. 240 ohms, /-36.9 degrees
B. 240 ohms, /36.9 degrees
C. 500 ohms, /53.1 degrees
D. 500 ohms, /-53.1 degrees

3-17B6 Using the polar coordinate system, what visual representation would you get of a voltage in a sinewave circuit?

A. To show the reactance which is present.
B. To graphically represent the AC and DC component.
C. To display the data on an XY chart.
D. The plot shows the magnitude and phase angle.

Answer Key: 3-17B1: D 3-17B2: B 3-17B3: C 3-17B4: A 3-17B5: B 3-17B6: D

Key Topic 18: Calculations

3-18B1 What is the magnitude of the impedance of a series AC circuit having a resistance of 6 ohms, an inductive reactance of 17 ohms, and zero capacitive reactance?

A. 6.6 ohms.
B. 11 ohms.
C. 18 ohms.
D. 23 ohms.

3-18B2 A 1-watt, 10-volt Zener diode with the following characteristics: $I_{min.} = 5$ mA; $I_{max.} = 95$ mA; and $Z = 8$ ohms, is to be used as part of a voltage regulator in a 20-V power supply. Approximately what size current-limiting resistor would be used to set its bias to the midpoint of its operating range?

A. 100 ohms.
B. 200 ohms.
C. 1 kilohms.
D. 2 kilohms.

3-18B3 Given a power supply with a no load voltage of 12 volts and a full load voltage of 10 volts, what is the percentage of voltage regulation?

A. 17 %
B. 80 %
C. 20 %
D. 83 %

3-18B4 What turns ratio does a transformer need in order to match a source impedance of 500 ohms to a load of 10 ohms?

A. 7.1 to 1.
B. 14.2 to 1.
C. 50 to 1.
D. None of these.

3-18B5 Given a power supply with a full load voltage of 200 volts and a regulation of 25%, what is the no load voltage?

A. 150 volts.
B. 160 volts.
C. 240 volts.
D. 250 volts.

3-18B6 What is the conductance (G) of a circuit if 6 amperes of current flows when 12 volts DC is applied?

A. 0.25 Siemens (mhos).
B. 0.50 Siemens (mhos).
C. 1.00 Siemens (mhos).
D. 1.25 Siemens (mhos).

Answer Key: 3-18B1: C 3-18B2: B 3-18B3: C 3-18B4: A 3-18B5: D 3-18B6: B

Key Topic 19: Photoconductive Devices

3-19C1 What happens to the conductivity of photoconductive material when light shines on it?
A. It increases.
B. It decreases.
C. It stays the same.
D. It becomes temperature dependent.

3-19C2 What is the photoconductive effect?
A. The conversion of photon energy to electromotive energy.
B. The increased conductivity of an illuminated semiconductor junction.
C. The conversion of electromotive energy to photon energy.
D. The decreased conductivity of an illuminated semiconductor junction.

3-19C3 What does the photoconductive effect in crystalline solids produce a noticeable change in?
A. The capacitance of the solid.
B. The inductance of the solid.
C. The specific gravity of the solid.
D. The resistance of the solid.

3-19C4 What is the description of an optoisolator?
A. An LED and a photosensitive device.
B. A P-N junction that develops an excess positive charge when exposed to light.
C. An LED and a capacitor.
D. An LED and a lithium battery cell.

3-19C5 What happens to the conductivity of a photosensitive semiconductor junction when it is illuminated?
A. The junction resistance is unchanged.
B. The junction resistance decreases.
C. The junction resistance becomes temperature dependent.
D. The junction resistance increases

3-19C6 What is the description of an optocoupler?
A. A resistor and a capacitor.
B. Two light sources modulated onto a mirrored surface.
C, An LED and a photosensitive device.
D. An amplitude modulated beam encoder.

Answer Key: 3-19C1: A 3-19C2: B 3-19C3: D 3-19C4: A 3-19C5: B 3-19C6: C

Key Topic 20: Capacitors

3-20C1 What factors determine the capacitance of a capacitor?

A. Voltage on the plates and distance between the plates.
B. Voltage on the plates and the dielectric constant of the material between the plates.
C. Amount of charge on the plates and the dielectric constant of the material between the plates.
D. Distance between the plates and the dielectric constant of the material between the plates.

3-20C2 In Figure 3C4, if a small variable capacitor were installed in place of the dashed line, it would?

A. Increase gain.
B. Increase parasitic oscillations.
C. Decrease parasitic oscillations.
D. Decrease crosstalk.

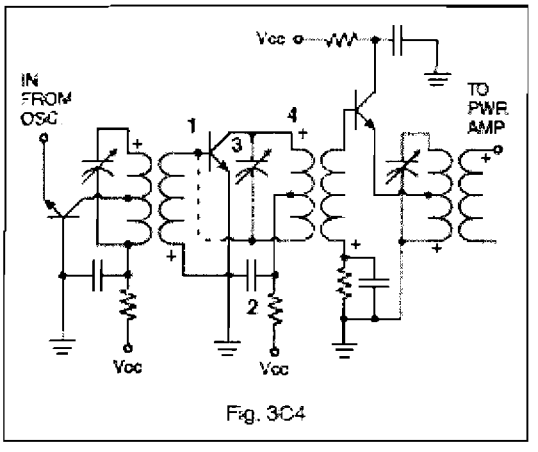

Fig. 3C4

3-20C3 In Figure 3C4, which component (labeled 1 through 4) is used to provide a signal ground?

A. 1
B. 2
C. 3
D. 4

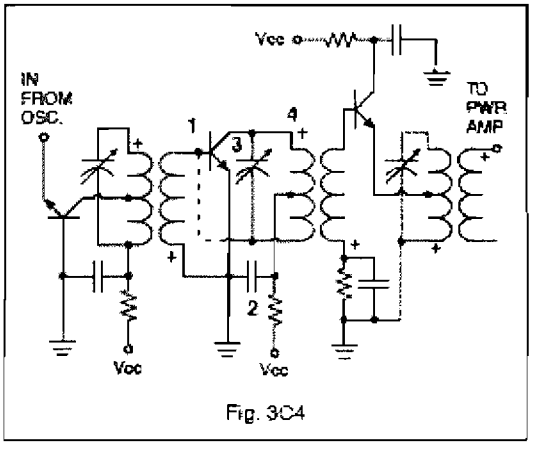

Fig. 3C4

3-20C4 In Figure 3C5, which capacitor (labeled 1 through 4) is being used as a bypass capacitor?

A. 1
B. 2
C. 3
D. 4

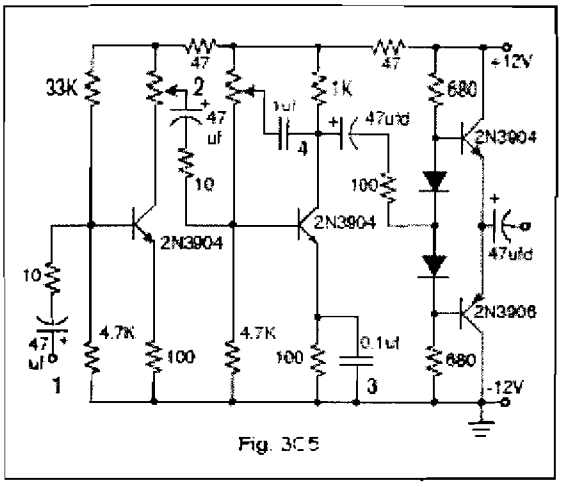

Fig. 3C5

3-20C5 In Figure 3C5, the 1 μF capacitor is connected to a potentiometer that is used to:

A. Increase gain.
B. Neutralize amplifier.
C. Couple.
D. Adjust tone.

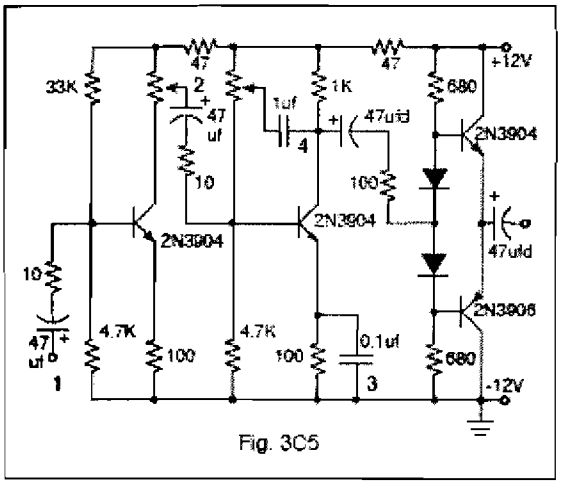

Fig. 3C5

3-20C6 What is the purpose of a coupling capacitor?

A. It blocks direct current and passes alternating current.
B. It blocks alternating current and passes direct current.
C. It increases the resonant frequency of the circuit.
D. It decreases the resonant frequency of the circuit.

Answer Key: 3-20C1: D 3-20C2: C 3-20C3: B 3-20C4: C 3-20C5: D 3-20C6: A

Key Topic 21: Transformers

3-21C1 A capacitor is sometimes placed in series with the primary of a power transformer to:
A. Improve the power factor.
B. Improve output voltage regulation.
C. Rectify the primary windings.
D. None of these.

3-21C2 A transformer used to step up its input voltage must have:
A. More turns of wire on its primary than on its secondary.
B. More turns of wire on its secondary than on its primary.
C. Equal number of primary and secondary turns of wire.
D. None of the above statements are correct.

3-21C3 A transformer primary of 2250 turns connected to 120 VAC will develop what voltage across a 500-turn secondary?
A. 26.7 volts.
B. 2300 volts.
C. 1500 volts.
D. 5.9 volts.

3-21C4 What is the ratio of the output frequency to the input frequency of a single-phase full-wave rectifier?
A. 1:1.
B. 1:2.
C. 2:1.
D. None of these.

3-21C5 A power transformer has a single primary winding and three secondary windings producing 5.0 volts, 12.6 volts, and 150 volts. Assuming similar wire sizes, which of the three secondary windings will have the highest measured DC resistance?
A. The 12.6 volt winding.
B. The 150 volt winding.
C. The 5.0 volt winding.
D. All will have equal resistance values.

3-21C6 A power transformer has a primary winding of 200 turns of #24 wire and a secondary winding consisting of 500 turns of the same size wire. When 20 volts are applied to the primary winding, the expected secondary voltage will be:
A. 500 volts.
B. 25 volts.
C. 10 volts.
D. 50 volts.

Answer Key: 3-21C1: A 3-21C2: B 3-21C3: A 3-21C4: C 3-21C5: B 3-21C6: D

Key Topic 22: Voltage Regulators, Zener Diodes

3-22C1 In a linear electronic voltage regulator:

A. The output is a ramp voltage.
B. The pass transistor switches from the "off" state to the "on"" state.
C. The control device is switched on or off, with the duty cycle proportional to the line or load conditions.
D. The conduction of a control element is varied in direct proportion to the line voltage or load current.

3-22C2 A switching electronic voltage regulator:

A. Varies the conduction of a control element in direct proportion to the line voltage or load current.
B. Provides more than one output voltage.
C. Switches the control device on or off, with the duty cycle proportional to the line or load conditions.
D. Gives a ramp voltage at its output.

3-22C3 What device is usually used as a stable reference voltage in a linear voltage regulator?

A. Zener diode.
B. Tunnel diode.
C. SCR.
D. Varactor diode.

3-22C4 In a regulated power supply, what type of component will most likely be used to establish a reference voltage?

A. Tunnel Diode.
B. Battery.
C. Pass Transistor.
D. Zener Diode.

3-22C5 A three-terminal regulator:

A. Supplies three voltages with variable current.
B. Supplies three voltages at a constant current.
C. Contains a voltage reference, error amplifier, sensing resistors and transistors, and a pass element.
D. Contains three error amplifiers and sensing transistors.

3-22C6 What is the range of voltage ratings available in Zener diodes?

A. 1.2 volts to 7 volts.
B. 2.4 volts to 200 volts and above.
C. 3 volts to 2000 volts.
D. 1.2 volts to 5.6 volts.

Answer Key: 3-22C1: D 3-22C2: C 3-22C3: A 3-22C4: D 3-22C5: C 3-22C6: B

Key Topic 23: SCRs, Triacs

3-23C1 How might two similar SCRs be connected to safely distribute the power load of a circuit?

A. In series.
B. In parallel, same polarity.
C. In parallel, reverse polarity.
D. In a combination series and parallel configuration.

3-23C2 What are the three terminals of an SCR?

A. Anode, cathode, and gate.
B. Gate, source, and sink.
C. Base, collector, and emitter.
D. Gate, base 1, and base 2.

3-23C3 Which of the following devices acts as two SCRs connected back to back, but facing in opposite directions and sharing a common gate?

A. JFET.
B. Dual-gate MOSFET.
C. DIAC.
D. TRIAC.

3-23C4 What is the transistor called that is fabricated as two complementary SCRs in parallel with a common gate terminal?

A. TRIAC.
B. Bilateral SCR.
C. Unijunction transistor.
D. Field effect transistor.

3-23C5 What are the three terminals of a TRIAC?

A. Emitter, base 1, and base 2.
B. Base, emitter, and collector.
C. Gate, source, and sink.
D. Gate, anode 1, and anode 2.

3-23C6 What circuit might contain a SCR?

A. Filament circuit of a tube radio receiver.
B. A light-dimming circuit.
C. Shunt across a transformer primary.
D. Bypass capacitor circuit to ground.

Answer Key: 3-23C1: C 3-23C2: A 3-23C3: D 3-23C4: A 3-23C5: D 3-23C6: B

Key Topic 24: Diodes

3-24C1 What is one common use for PIN diodes?
- A. Constant current source.
- B. RF switch.
- C. Constant voltage source.
- D. RF rectifier.

3-24C2 What is a common use of a hot-carrier diode?
- A. Balanced inputs in SSB generation.
- B. Variable capacitance in an automatic frequency control circuit.
- C. Constant voltage reference in a power supply.
- D. VHF and UHF mixers and detectors.

3-24C3 Structurally, what are the two main categories of semiconductor diodes?
- A. Junction and point contact.
- B. Electrolytic and junction.
- C. Electrolytic and point contact.
- D. Vacuum and point contact.

3-24C4 What special type of diode is capable of both amplification and oscillation?
- A. Zener diodes.
- B. Point contact diodes.
- C. Tunnel diodes.
- D. Junction diodes.

3-24C5 What type of semiconductor diode varies its internal capacitance as the voltage applied to its terminals varies?
- A. Tunnel diode.
- B. Varactor diode.
- C. Silicon-controlled rectifier.
- D. Zener diode.

3-24C6 What is the principal characteristic of a tunnel diode?
- A. High forward resistance.
- B. Very high PIV(peak inverse voltage).
- C. Negative resistance region.
- D. High forward current rating.

Answer Key: 3-24C1: B 3-24C2: D 3-24C3: A 3-24C4: C 3-24C5: B 3-24C6: C